COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH SECRETARIAT
PUBLIC WATER SUPPLY SUPERVISION PROGRAM

Specifications to Determine the Outstanding Performance of a System

PRDOH community water systems that are classified as having outstanding performance are eligible for having future sanitary surveys conducted at least once every five years, rather than at least once every three years. It will depend on conclusive special conditions, the findings of previously and actual sanitary surveys and the recommendations of the inspector in a case-by-case basis. The inspector must include in the report a recommendation on whether the system is eligible to have outstanding performance based on the findings of the sanitary survey.

Along with the recommendation, the report must include the following note: "The recommendation for outstanding performance status is contingent upon the system continuing to meet PRDOH's specifications for that status". Outstanding performance means that the system is well operated and managed, has a good record of performance in past sanitary surveys, and has not had any violations at least in three years.

PRDOH has determined and prepared the specifications to determine the outstanding performance of a system. The specifications for outstanding performance includes, but are not limited to the following factors:

- ______ No violations of MCLs since the last sanitary survey;
- ______ No violations of monitoring and reporting requirements since the last sanitary survey;
- ______ No violations of primary drinking water regulations during the past five years;
- ______ No waterborne disease outbreaks attributable to the water system during the past five years;
- ______ Past sanitary surveys containing no significant deficiencies;
- ______ Existence of emergency preparedness measures and backup facilities;
- ______ Meeting exceptional performance standards (i.e., 0.1 NTU 95 percentage of the time);

- ____ Expert management of system (e.g., managers are knowledgeable about providing quality drinking water; low staff turnover and positive staff morale; well-established water quality goals);
- ____ Expert operation of the system (e.g., skilled, certified personnel) in adequate numbers; existence of quality O&M manuals that are used by the staff; adequate budget and revenues);
- ____ Effective cross-connection program developed and implemented;
- ____ Recognized in-house research programs applicable to improved system performance;
- ____ Active public outreach programs (e.g., citizen participation committees);
- ____ Stable water source (no interruptions in supply);
- ____ Source water supply drawn from a reservoir or pre-sedimentation facility that effectively dampens raw water quality variations;
- ____ No identified significant risk of future violations or problems (e.g., equipment past its service life);
- ____ System capacity sufficient to meet anticipated growth;
- ____ The water system has adequately addressed all performance limiting factors identified by the last CPE performed;
- ____ Other: ______________________________

  ____

Commonwealth of Puerto Rico
Department of Health

COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH SECRETARIAT
PUBLIC WATER SUPPLY SUPERVISION PROGRAM

Proposed Minimum Criteria for Approving Third Parties to Conduct a Comprehensive Performance Evaluation

The Puerto Rico Department of Health (PRDOH) recognizes that Comprehensive Performance Evaluations (CPE's) conducted as a follow-up action to the exceedance of individual filter turbidity monitoring triggers required by the Interim Enhanced Surface Water Treatment Rule (IESTWR) must be conducted by train and qualified experts who are proficient in this area of expertise. The PRDOH proposed the following core criteria to address minimum requirements under the IESTWR §142.16(g)(1) for CPE's to be conducted in PR:

1. CPE's will be conducted by in-house (state staff) experts who are fully trained, have demonstrate sufficient experience in conducting CPE's and have received certification by PRDOH.
2. CPE's will be conducted by approved third party experts who meet the following requirements:
    a. Each individual participating in a third party CPE must be fully trained (have participated as a trainee in three CPE's of progressively increasing responsibility under the CPE training regimen set forth by the EPA or one of its affiliates);
    b. Each individual participating in a third party CPE must demonstrate they have sufficient experience in conducting CPE's;
    c. Each individual participating in a third party CPE must provide and be proficient in the use of all equipment and computer software associated with conducting a CPE (i.e.: Equipment, materials and chemicals used must be approved by EPA, NSF, etc.)
    d. Each individual participating in a third party CPE must have received certification by PRDOH;
3. Additional conditions of approval:
    a. The firms which conducts a third party CPE may be joined on-site by the PRDOH certified CPE experts who would observe the CPE being conducted and provide and in-depth review of the CPE report.
    b. Third party firm CPE's must be conducted as specified in EPA's Guidance Manual "Optimizing Water Treatment Plant Performance Using Composite Correction Program", 1998 ed.
    c. Each report developed by a third party firm is subject to review and either approval or disapproval by PRDOH.
4. CPE's evaluation team capabilities:
    a. Technical skills/knowledge: water treatment plant design, water treatment plant operations and process control, regulatory requirements, maintenance and utility management.
    b. Leadership skills: communication, organization, motivation, decisiveness and interpretational skills.

Commonwealth of Puerto Rico
Department of Health

COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF HEALTH
OFFICE OF THE SECRETARY

August 5, 2002

Public Water System
Owner and/or Operator

RE: Administrative Order 2002-365-02
Order to establish requirements for systems to conduct a Composite Correction Program (CCP)

Public Water System Owner and/or Operator:

Act No. 5, approved on July 21, 1977, known as the Act to Protect the Purity of the Drinking Water in the Commonwealth of Puerto Rico, authorize the Secretary of Health to promulgate and enforce the necessary regulations to protect the purity of the drinking water supply in Puerto Rico and to protect the health of the people served by those systems as well. In May 1980, the Environmental Protection Agency (EPA) granted the Puerto Rico Department of Health (PRDOH) primacy for all existing national primary drinking water regulations in Puerto Rico.

EPA has promulgated the Interim Enhance Surface Water Treatment Rule (IESWTR), which requires states to make sure that systems conduct a Composite Correction Program (CCP) and implement any follow up findings from the CCP, §142.16(g)(1).

The CCP has been developed and has demonstrated to be a method of optimizing surface water treatment plant performance with respect to protection from microbial pathogens. The CCP consists of a Comprehensive Performance Evaluation (CPE) and a Comprehensive Technical Assistance (CTA).

A CPE is a thorough review and analysis of a plant's design capabilities and associated administrative, financial, technical, operation and maintenance practices. It is conducted to identify factors that may be adversely impacting a plant's capability to achieve optimal performance. Its major objective is to determine if significant improvements in performance can be achieved without major capital improvements.

A CTA is the performance improvement phase that is implemented if the CPE results indicate improvement performance potential. During the CTA phase, identified plant specific factors are systematically addressed and eliminated.

To this extent, the PRDOH in its ministerial role to watch over the health of the Puerto Rican people, and in accordance with the provisions in Act No. 5 and the drinking water regulation, order and require that:

1. Systems must arrange to conduct a comprehensive performance evaluation (CPE) as a follow-up action to the exceedance of individual filter turbidity monitoring triggers, as required by §141.175(b)(4):
   a. The system must arrange for the conduct of a CPE no later than thirty (30) days following the exceedance;
   b. The system must have the evaluation completed and submitted to PRDOH no later than ninety (90) days following the exceedance.
2. PRDOH will require systems to conduct a Comprehensive Technical Assistance (CTA) when the CPE required by the triggers in §141.175(b)(4) of the rule show that a CTA would be beneficial.
3. The CPE must be conducted by fully trained and qualified experts who are proficient in this area of expertise:
   a. CPE's will be conducted by in-house (state staff) or approved third party experts who have received certification by PRDOH.
4. Systems will implement any follow up recommendations that result as part of the CCP, as established in §142.16(g)(1), in a case-by-case-basis.

All actions which willfully violates any of the requirements previously described shall be subject to administrative and/or legal enforcement actions, as well as penalties in accordance with the applicable rules and laws in force.

This Order, under the power granted to the Secretary of Health on Section #5 of Act No. 5, will be in force immediately after its approval.

Cordially,

Johnny Rullán, MD, FACPM
Secretary of Health

Cc: Mr. Carl Soderberg, EPA-CEPD
Mr. Bruce Kiselica, EPA-NY
Mr. Alfredo Casta Vélez, Aux. Secretary-DOH
Ms. Olga I. Rivera, PWSSP Dir.-DOH
Esq. Mayra Maldonado, Legal Div. Dir.-DOH

TABLE E-11

CT VALUES FOR
INACTIVATION OF VIRUSES BY OZONE[1]

Inactivation	Temperature (C) ≤=1	5	10	15	20	25
2-log	0.9	0.6	0.5	0.3	0.25	0.15
3-log	1.4	0.9	0.8	0.5	0.4	0.25
4-log	1.8	1.2	1.0	0.6	0.5	0.3

Note:

1. Basis for values given in Appendix F.

TABLE E-13

CT VALUES FOR
INACTIVATION OF VIRUSES BY CHLORAMINE[1]

Inactivation	Temperature (C) <=1	5	10	15	20	25
2-log	1,243	857	643	428	321	214
3-log	2,063	1,423	1,067	712	534	356
4-log	2,883	1,988	1,491	994	746	497

Notes:

1. Basis for values given in Appendix F.

APPENDIX G-2

DETERMINING CHLORAMINE INACTIVATION OF VIRUS FOR THE SURFACE WATER TREATMENT RULE

Microbiological Treatment Branch
Risk Reduction Engineering Laboratory

and

Parasitology and Immunology Branch
Environmental Monitoring Systems Laboratory
U.S. Environmental Protection Agency
26 West Martin Luther King Drive
Cincinnati, Ohio 45268

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The Surface Water Treatment Rule requires 99.99% or greater removal/inactivation of viruses. The following protocol may be used to determine the percentage of virus inactivation obtained by a treatment plant using chloramine disinfection.

I. MATERIALS

A. Materials for Disinfection

1. Stock chlorine solution
2. Stock ammonia solution
3. Stirring device
4. Incubator or water bath for less than ambient temperature
5. Water from treatment plant
6. MS2 bacteriophage
7. Assorted glassware
8. Assorted pipettes
9. Aqueous, sterile sodium thiosulfate solution
10. Refrigerator
11. Vortex mixer
12. Timer

B. Materials for MS2 Assay

1. MS2 bacteriophage and its *Escherichia coli* host
2. Assorted glassware
3. Assorted pipettes
4. Incubator, 37°C
5. Refrigerator
6. Petri dishes, 100 x 15 mm, sterile
7. Vortex mixer
8. Water bath, 45°C
9. Sterile rubber spatula
10. EDTA, disodium salt
11. Lysozyme, crystallized from egg white
12. Centrifuge with swinging bucket rotor

II. REAGENTS AND MEDIA

A. Tryptone-Yeast Extract (TYE) Broth

Ingredient	Amount
Bacto tryptone	10.0 g
Yeast extract	1.0 g
Glucose	1.0 g
NaCl	8.0 g
1.0 M $CaCl_2$	2.0 ml

Dissolve in distilled water to a total volume of 1.0 liter, then add 0.3 ml of 6.0 M NaOH. This medium should be sterilized either by autoclaving for 15 minutes at 121°C or filtration through a 0.22 μm porosity membrane and then stored at approximately 4°C. It is used in preparing bacterial host suspensions for viral assays.

B. Tryptone-Yeast Extract (TYE) Agar

Ingredient	Amount
TYE broth	1.0 liter
Agar	15.0 g

The agar should be added to the broth prior to sterilization. The medium should be sterilized by autoclaving for 15 minutes at 121°C. This medium is used to prepare slant tubes for maintenance of bacterial stock cultures. The prepared slant tubes should be stored at approximately 4°C.

C. Bottom Agar for Bacteriophage Assay

Ingredient	Amount
Bacto tryptone	10.0 g
Agar	15.0 g
NaCl	2.5 g
KCl	2.5 g
1.0 M $CaCl_2$	1.0 ml

Dissolve the ingredients in distilled water to a total volume of 1 liter. The medium should be sterilized by autoclaving for 15 minutes at 121°C. After autoclaving and cooling, store at 4°C. Immediately prior to use, liquefy the medium by heating. Add approximately 15 ml of liquefied agar into each Petri dish. This bottom layer serves as an anchoring substrate for the top agar layer.

D. Top Agar for Bacteriophage Assay

Ingredient	Amount
Bacto tryptone	10.0 g
Agar	8.0 g
NaCl	8.0 g
Yeast extract	1.0 g
Glucose	1.0 g
1.0 M $CaCl_2$	1.0 ml

Dissolve the ingredients in distilled water to a total volume of 1 liter. This medium should be sterilized by autoclaving 15 minutes at 121°C. After cooling, store at 4°C until needed in bacteriophage assays. Immediately prior to use in assays, liquefy the medium by heating and then cool to and maintain at a temperature of 45°C.

E. Salt Diluent for Bacteriophage Assay

Ingredient	Amount
NaCl	8.5 g
1.0 M $CaCl_2$	2.0 ml

Dissolve in distilled water to a total volume of 1 liter. This diluent should be sterilized either by autoclaving for 15 minutes at 121°C or filtration through a 0.22 µm porosity membrane. Store at room temperature.

F. $CaCl_2$, 1.0 M

Ingredient	Amount
$CaCl_2$	11.1 g

Dissolve in distilled water to a total volume of 100 ml. Autoclave 15 minutes at 121°C or filter sterilize the solution through a 0.22 µm porosity membrane. Store at room temperature.

G. Sodium Thiosulfate, 1%

Ingredient	Amount
Sodium thiosulfate	1.0 g

Dissolve the sodium thiosulfate in 50 ml distilled water. Adjust the volume to 100 ml with additional distilled water. Filter sterilize the solution through a 0.22 µm porosity membrane or autoclave 15 minutes at 121°C. Store at room temperature.

III. MS2 BACTERIOPHAGE ASSAY

A. Microorganisms

1. MS2 bacteriophage: catalog number 15597-B1, American Type Culture Collection, 12301 Parklawn Drive, Rockville, MD 20852

2. Bacterial host: Escherichia coli, catalog number 15597, American Type Culture Collection.

B. Growth and Maintenance of Microorganisms

1. Preparation of bacterial host stock cultures

Inoculate host bacteria onto TYE agar slant tubes, incubate 24 hours at 37°C to allow bacterial growth, and then refrigerate at 4°C. At monthly intervals the cultured bacterial hosts should be transferred to a new TYE agar slant.

2. Preparation of bacteriophage stock suspension

Melt top agar and maintain at 45°C. Add 3 ml of the agar to a 13 x 100 mm test tube contained in a rack in a 45°C water bath. Add 0.5 to 1.0 ml of the bacteriophage suspension diluted so that the host bacterial "lawn" will show nearly complete lysis after overnight incubation. Add 0.1 to 0.2 ml of a TYE broth culture of the host bacteria that has been incubated overnight. Mix gently and pour the contents on the surface of bottom agar contained in a Petri dish that has been prepared previously. Rock the Petri dish to spread the added material evenly over the agar surface. After the top agar solidifies (about 15 minutes), invert the Petri dish and incubate overnight at 37°C. Repeat the above procedure so that a minimum of 5 but no more than 10 Petri dishes are prepared.

Following this incubation and using a sterile rubber spatula, gently scrape the top and bottom agar layers into a large beaker. Add to this pool of agar layers an amount of TYE broth sufficient to yield a total volume of 80 ml. To this mixture add 0.4 g of EDTA (disodium salt) and 0.052 g of lysozyme (crystallized from egg white). Incubate this mixture at room temperature for 2 hours with continuous mixing. Then centrifuge the mixture for 15 minutes at 3,000 x g. Carefully remove the upper fluid layer. This fluid layer constitutes a viral stock suspension for use in subsequent testing and assays. The viral stock suspension may be divided into aliquots and stored either frozen or at 4°C.

C. Performance of Bacteriophage Assay

A two-week supply of Petri dishes may be poured with bottom agar ahead of time and refrigerated inverted at 4°C. If stored in a refrigerator, allow agar plates to equilibrate to room temperature

before use. Eighteen hours prior to beginning a bacteriophage assay, prepare a bacterial host suspension by inoculating 5 ml of TYE broth with a small amount of bacteria taken directly from a slant tube culture. Incubate the broth containing this bacterial inoculum overnight (approximately 18 hours) at 37°C immediately prior to use in bacteriophage assays as described below. This type of broth culture should be prepared freshly for each day's bacteriophage assays. If necessary, a volume greater than 5 ml can be prepared in a similar manner.

On the day of assay, melt a sufficient amount of top agar and maintain at 45°C in a water bath. Place test tubes (13 x 100 mm) in a rack in the same water bath and allow to warm, then add 3 ml of top agar to each tube. Inoculate the test tubes containing top agar with the bacteriophage samples (0.5 to 1.0 ml of the sample/tube) plus 0.1 to 0.2 ml of the overnight bacterial host suspension. Dilute the bacteriophage samples from 10^{-1} to 10^{-4} in salt diluent prior to inoculation and assay each dilution in triplicate. In addition, assay the uninoculated salt diluent as a negative control. Agitate the test tubes containing top agar, bacteriophage inoculum, and bacterial host suspension gently on a vortex mixer, and pour the contents of each onto a hardened bottom agar layer contained in an appropriately numbered dish. Quickly rock the Petri dishes to spread the added material evenly, and place on a flat surface at room temperature while the agar present in the added material solidifies (approximately 15 minutes). Invert and incubate the dishes at 37°C overnight (approximately 18 hours). The focal areas of viral infection which develop during this incubation are referred to as "plaques" and, if possible, should be enumerated immediatly after the incubation. If necessary, the incubated Petri dishes can be refrigerated at 4°C overnight prior to plaque enumeration. As a general rule, count only those plates that contain between 20 and 200 plaques.

IV. DISINFECTION PROCEDURE

A. The treatment plant water to be used should be the water influent into the chloramine disinfection unit process used in the plant. If chloramine disinfection is performed at more than one point in the treatment process, e.g. prefiltration and postfiltration, the procedure should simulate as closely as possible actual treatment practice.

B. Prepare stock ammonia and chlorine solutions to be added to the treatment plant water to achieve the same stoichiometric relationship between chlorine and ammonia that is used in the water treatment plant. These solutions should be concentrated enough so that no more than 2 ml of each solution will be added to the treatment plant water being disinfected.

C. Determine the contact time by the methods described in the Surface Water Treatment Rule and/or the associated Guidance Manual.

D. Rinse two 600 ml beakers with treatment plant water to remove any extraneous material that may cause disinfectant demand. Then add 400 ml treatment plant water to the beaker. The first beaker will be seeded with MS2 before the contents are chloraminated. The second beaker will be an indigenous virus control and will be chloraminated without addition of extraneous phage.

E. Mix the contents of the beaker short of producing a vortex in the center and continue until the conclusion of the experiment.

F. Equilibrate the 600 ml beakers and their contents as well as the disinfectant reagents to the desired experimental temperature.

G. Dilute the stock MS2 bacteriophage so that the bacteriophage concentration is 1 to 5 x 10^8 PFU/ml.

H. Add 1.0 ml of the diluted MS2 bacteriophage to the contents of the first 600 ml beaker.

I. Remove a 10 ml sample from the contents of the first beaker after 2 minutes of mixing. Assay the MS2 bacteriophage concentration in this sample within 4 hours and record the results as PFU/ml. This value is the initial MS2 concentration.

J. Remove a 10 ml sample from the contents of the second beaker after 2 minutes of mixing. Assay the indigenous bacteriophage concentration in this sample within 4 hours (at the same time as you assay the sample from the first beaker) and record the results as PFU/ml. This value is the initial unseeded concentration.

K. Add the disinfectant reagents to the contents of both beakers using the same sequence, time, and concentrations as are used in the actual treatment plant operations.

L. Just prior to the end of the contact time, remove a volume of sample adequate for determination of the disinfectant residual concentration from both beakers. Use methods prescribed in the Surface Water Treatment Rule for the determination of combined chlorine. This residual should be the same (±20%) as the residual present in the treatment plant operation.

M. At the end of the exposure time, remove a 10 ml sample from the first 600 ml beaker and neutralize with 0.25 ml of 1.0% aqueous, sterile sodium thiosulfate. Assay for the MS2 bacteriophage survivors and record the results as PFU/ml. This value is the exposed MS2 concentration.

N. At the end of the exposure time, remove a 10 ml sample from the second 600 ml beaker and neutralize with 0.25 ml of 1.0% aqueous, sterile sodium thiosulfate. Assay for the indigenous bacteriophage survivors and record the results as PFU/ml. This value is the exposed unseeded concentration.

V. PROCEDURE FOR DETERMINING INACTIVATION

A. Calculation of Percentage Inactivation

Use the following formula to calculate the percent inactivation of MS2:

1. % inactivation = 100% - [(exposed MS2/initial MS2) x 100]

Using values from Section IV steps I, J, M and N calculate initial MS2 and exposed MS2 as follows:

2. Initial MS2 (PFU/ml) = I - J.

3. Exposed MS2 (PFU/ml) = M - N.

If the number of PFU/ml in exposed MS2 is zero, i.e., no plaques are produced after assay of undiluted and diluted samples, use <1 PFU/ml as the value in the above formula.

B. Comparison of Percentage Inactivation to Log_{10} of Inactivation

68% inactivation is equivalent to 0.5 $\log_{10}$ inactivation
90% inactivation is equivalent to 1 $\log_{10}$ inactivation
99% inactivation is equivalent to 2 $\log_{10}$ inactivation
99.9% inactivation is equivalent to 3 $\log_{10}$ inactivation

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VII. <u>TECHNICAL CONTACTS</u>:

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G.4 DETERMING OZONE INACTIVATION OF GIARDIA CYSTS AND VIRUS

G.4.1 BACKGROUND

The basis for the ozone CT values are given in Appendices F.1.2 (Giardia cysts) and F.2.4 (Virus). As indicated, both sets of CT values are based on limited data and because of this, the values established are conservative and employ large safety factors. In addition, the difference between the way the laboratory experiments used to develop the CT values and how ozone is used in water treatment presents a problem with translating the data for field use. The laboratory studies were conducted using steady state ozone concentrations with ozone continually added during the contact period. In contrast, steady state ozone concentrations are not maintained in field use. Also, the effectiveness of ozone contactors used in field applications may vary from each other and from the mixing efficiencies applied in the laboratory experiments used to establish the CT values.

The net effect of all of these differences is to limit the applicability of the CT values in the SWTR and Guidance Manual to individual systems. Therefore, the option of allowing the Primacy Agency to consider the use of lower CT values by individual systems has been provided.

This approval should be based on acceptable experimental data provided by the system. In general, the procedures provided in Appendix G.1 for determining Giardia cyst inactivation and Appendix G.2 for determining virus inactivation can be used. However, unlike chloramines ozone is not a stable disinfectant. Because of ozone's rapid dissipation, a pilot study must be used in lieu of the batch system to demonstrate the disinfection efficiency. General considerations for conducting pilot studies to demonstrate the disinfection ability of ozone or any other unstable disinfectant are enumerated below.

G.4.2 GENERAL CONSIDERATIONS FOR PILOT TEST

A. All microorganisms, reagents and media are prepared as indicated in sections G.1 for Giardia and G.2 for virus.

B. The disinfectant should be prepared, measured and added to the test water as it would be added to the water at the water treatment plant.

C. Specific reactor design should be a function of the disinfectant and reflect how the disinfectant is added at the water treatment plant. Provisions should be made to determine concentration of disinfectant and microbial survival to be measured with contact time.

An example of conducting a pilot test for a plug flow reactor using ozone or another unstable disinfectant is provided below.

Example - Plug Flow Reactor Protocol

The size of the plug flow reactor can be approximated from the table below. Glass, stainless steel, copper, plastic tubing or other material compatible with the disinfectant can be used to construct the plug flow reactor. Table 1 shows the approximate length of pipe for a plug flow reactor to yield 10 minutes contact at flow rates between 50 and 500 ml/min. Depending on pipe size and material an economical reactor can be constructed.

TABLE 1. APPROXIMATE LENGTH AND DIAMETER OF PIPE BASED ON FLOW

FLOW ml/min	TIME MIN.	VOLUME LITERS	CC	LINEAR PIPE-LENGTH, METERS NOMINAL PIPE DIAMETER, CM 0.6 / 0.28	1.2 / 1.31	1.8 / 2.54	2.54 / 5.07	3.81 / 11.40	5.08 / 20.27
50	10	0.5	500	17.7	4.4	2.0	1.0	0.4	0.2
100	10	1	1000	35.4	8.8	3.9	2.0	0.9	0.5
200	10	2	2000	70.7	17.7	7.9	3.9	1.8	1.0
300	10	3	3000	106.1	26.5	11.8	5.9	2.6	1.5
400	10	4	4000	141.5	35.4	15.7	7.9	3.5	2.0
500	10	5	5000	176.8	44.2	19.6	9.9	4.4	2.5

Additional information on the design of specific pilot studies can be found in the following references by Thompson (1982), Montgomery (1985), and Al-Ani (1985).

Additional Materials to those in G.1 and/or G.2

plug flow reactor

cyst suspension, $2x10^7$ cysts/trial

cyst quantity - cysts are prepared as indicated in G.1.

10^3 cysts/ml X 20,000 ml = $2x10^7$ cysts required/trial.

MS2 stock, $2x10^{10}$/trial

2-20 liter (5 gal) carboy

test water pump, mid range 200 ml/min

disinfectant generator

disinfectant pump, mid range 10-20 ml/min

disinfectant residual reagents and equipment

Test Procedure

A. Reactor conditions

1. Test Water Flow rate= 200 ml/min (this may vary from 50 to 500 ml/min with 20 l reservoir total experimental time= 100 min)
2. Disinfectant flow
   gas-requires specific contactor designed for disinfectant
   Liquid=10 to 20 ml/min
3. Temperature
   controlled
4. Prepare 20 liter reservoir (5 gal) of test water at the pH and temperature of the CT trial. Do not add microorganisms
5. Prepare 20 liter reservoir (5 gal) of test water and equilibrate to the temperature of the CT trial. Add *Giardia muris* cysts at an initial density of 10^3 cysts/ml and/or MS2 bacterial virus at an initial density of 10^6 PFU/ml. Mix thoroughly and adjust pH to the pH of the CT trial. Continuous mixing of the test water feed stock should be carried out over the course of the CT trial to prevent the *Giardia* cysts from settling.

B. Disinfection Procedure - Prior to Disinfection Trial

1. Determine contact time for the sample ports in the plug flow reactor under conditions of the CT trial by methods described in the SWTR.
2. Determine disinfectant concentration with no microorganisms in the feed test water.

C. CT Trial Procedure

1. Start test water feed without cysts and or virus (approx. 200 ml/min), start disinfectant feed (gas or liquid).
   Allow system to equilibrate.
   Monitor disinfectant residual by appropriate method during this time. Samples for disinfectant residual should be taken directly into tubes or bottles containing reagents to fix the disinfectant at the time the sample is collected. Keep a plot of disinfectant residual vs running time to evaluate steady state conditions.
2. After the disinfectant residual has stabilized, switch to the reservoir containing the test microorganism(s).
3. Allow system to equilibrate for a time = 3 X final contact time.
   example
   final contact time =10 min, allow 30 min.
4. Monitor disinfectant residual by appropriate method during this time. If the disinfectant residual is stable begin chemical and biological sampling for calculation of CT.
5. Sampling
   a. Chemical
      A sufficient volume (about 250 ml should be collected from the sampling tap prior to the biological composite to determine:
         pH
         Residual disinfectant - Samples should be collected directly into tubes or bottles containing reagents to fix the disinfectant at the time the sample is collected.
   b. Biological
      Samples for microbial analysis are collected as short time composite samples over a 10 to 20 minute time period. Several trials may run for a given 20 liter test water preparation as long as sufficient equilibra-

tion and flow recovery times are allowed between trials.

- Zero time samples should be collected as 250 ml composite samples either directly from the test water feed reservoir or in line prior to the addition of the disinfectant.

- Four 250 ml samples are collected separately into a 2 l sterile bottle containing a neutralizing agent for the particular disinfectant. Each sample is thoroughly mixed upon collection and stored at 4 C. If multiple sample ports are used, the order of collection should be from longest to shortest contact time to minimize flow changes due to sampling.

6. <u>Giardia</u> cyst recovery and assay.

Concentrate the 1000 ml composite sample by filtration according to the method given in section G.1. Record and report the data as described in section G.1. The expected cysts/sample is given below:

Cysts/sample = 4 x 250 ml X 10^3 cyst/ml = 1×10^6cyst/sample.

7. Virus Assay

Before filtration for <u>Giardia</u>, remove 10.0 ml from the biological composite sample to a sterile screw cap culture tube containing 2 to 3 drops chloroform. Assay for MS2, record and report the virus data according to the methods and procedures described in G.2. Be sure to correct the <u>Giardia</u> sample volume to 990 ml.

8. Calculation of CT

Calculate CT in a manner described in Section G.1 for <u>Giardia</u> and Section G.2 for virus. The residual disinfectant should be the average of the four residual determinations performed prior to the individual samples collected for the biological composite and the time should be the time determined for the sample port under similar flow conditions.

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Estado Libre Asociado de Puerto Rico
Departamento de Salud
Secretaría Auxiliar para Salud Ambiental
Programa de Agua Potable

30 de abril de 2001

Sr. Jean M. Philipot
Director Técnico y Cumplimiento
Compañía de Aguas de Puerto Rico
Apartado 7066, Bo. Obrero Station
Santurce, P.R. 00916

Re: **Cambio de punto de aplicación de cloro**
Planta de Filtración Guaynabo (2591)

Estimado señor Philipot:

Luego de evaluar el protocolo sometido para el proyecto en referencia, le indicamos que autorizamos el mismo. Se deberá cumplir con lo siguiente:

1. Mantener y demostrar en todo momento el residual de desinfectante activo a través del sistema de distribución.
2. Asegurar en todo momento el cumplimiento con el punto de referencia o "bench mark" según el Protocolo aprobado.
3. Asegurar en todo momento cumplimiento con el mínimo de 3 log remoción/ inactivación de Giardia (99.9%).
4. Someter informes semanales que incluya la información requerida y el progreso del Protocolo.

Esta aprobación es válida por un período de treinta (30) días y bajo todos y cada uno de las condiciones especificadas en el Protocolo. Luego de esta fecha el Departamento de Salud evaluará su efectividad en la reducción de TTHM's.

Sin otro particular, quedo.

Cordialmente

Olga I. Rivera
Directora
Programa Agua Potable

Cf: Alfredo Casta-SASA
Ing. Jesús Sáez-PAP
Ing. Emma Blanco-PAP
Ing. Elvín Vélez-CAPR

I- APROBACION PROTOCOLO DE OPERACION PRUEBA DEL CAMBIO PUNTO PRE-CLORINACION

Este documento contiene la información necesaria sobre las condiciones operacionales de la Planta de Filtración Los Filtros de Guaynabo y el plan de manejo requerido por el Departamento de Salud para realizar el cambio del punto de pre-clorinación por un periódo de treinta días. Esto forma parte de la planificación de Compañía de Aguas de Puerto Rico para lograr la reducción en la formación de trihalometanos en el Sistema Metropolitano. Las siguientes personas revisaron, comentaron y aprobaron este documento para que oficialmente conste como el procedimiento a ejecutar para dicha prueba.

PREPARADO POR: ______________________ FECHA: 11/abril/01

Elvin O. Vélez Cedeño
Gerente de Producción CAPR
Responsable de la Prueba

APROBADO POR: ______________________ FECHA: 12/abril/01

Marc Zacharías
Director Región Metro CAPR

______________________ FECHA: 4-12-01

for Jean Marc Philipot
Director Departamento Técnico
y de Cumplimiento CAPR

______________________ FECHA: 4-30-01

Olga Rivera
Directora Programa Agua Potable
Departamento de Salud

compañía de aguas de Puerto Rico

27 de marzo de 2001

Olga Rivera, Directora
Programa de Agua Potable
Departamento de Salud

RE: Aprobación Protocolo sobre el Cambio del Punto de Preclorinación en Sergio Cuevas WFP

Sra. Rivera:

Sometemos el documento en asunto revisado e incorporando los requerimientos del Departamento de Salud (DOH) según carta recibida con fecha del 19 de marzo de 2001. Además se incluye adjunto todos los resultados de análisis llevados a cabo durante el "Information Collection Rule" (ICR) de varias plantas de filtración y, entre ellas, Sergio Cuevas WFP.

Le reiteramos que semanalmente se le proveerá al DOH todos los resultados obtenidos en la prueba, asi como las certificaciones requeridas; y el mantenimiento de las condiciones y modificaciones tal como detallamos en el plan propuesto.

Incluyo una hoja de aprobaciones la cual se incorporaría al documento finalmente aprobado. Por tanto, le agradezco que tan pronto hayan aceptado este protocolo nos envíen dicha hoja. Cualquier aclaración, agradezco que se comunique conmigo al 620-2277 ext. 2118, 2120 ó al celular 406-4713.

Cordialmente,

Elvin Vélez Cedeño
Gerente Regional de Producción

Cc: Marc Zacharías, Jean Marc Philipot, Marcos Negrón, Reading File

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una empresa de VIVENDI

I- APROBACION PROTOCOLO DE OPERACION PRUEBA DEL CAMBIO PUNTO PRE-CLORINACION

Este documento contiene la información necesaria sobre las condiciones operacionales de la Planta de Filtración Sergio Cuevas Bustamante y el plan de manejo requerido por el Departamento de Salud para realizar el cambio del punto de pre-clorinación por un periódo de treinta días. Esto forma parte de la planificación de Compañía de Aguas de Puerto Rico para lograr la reducción en la formación de trihalometanos en el Sistema Metropolitano. Las siguientes personas revisaron, comentaron y aprobaron este documento para que oficialmente conste como el procedimiento a ejecutar para dicha prueba.

PREPARADO POR: ______________________ FECHA: 23/marzo/01
Elvin O. Vélez Cedeño
Gerente de Producción CAPR
Responsable de la Prueba

APROBADO POR: ______________________ FECHA: 03/23/01
Marc Zacharías
Director Región Metro CAPR

______________________ FECHA: 3/23/01
Jean Marc Philipot
Director Departamento Técnico
y de Cumplimiento CAPR

______________________ FECHA: 3/29/01
Olga Rivera
Directora Programa Agua Potable
Departamento de Salud

Jpe

Departamento de Salud
Secretaría Auxiliar para Salud Ambiental
Programa de Agua Potable

8 de junio de 2001

Sr. Jean M. Philipot
Director Técnico y Cumplimiento
Compañía de Aguas de Puerto Rico
Apartado 7066, Bo. Obrero Station
Santurce, P.R. 00916

Re: Evaluación de cambio de punto aplicación cloro PF Ramey (3293)

Estimado señor Philipot:

Acusamos recibo de su comunicado fechado el 14 de mayo de 2001 donde indica que se llevará a cabo una evaluación sobre un posible cambio en el punto de aplicación de cloro en la planta de filtros en referencia.

El propósito de este comunicado es recordarle que de acuerdo a la reglamentación de agua potable, antes que se realice cualquier modificación significativa al proceso de tratamiento para cumplir con el Nivel Máximo de Contaminante de trihalometanos, se deberá someter y obtener una aprobación del Secretario de un Plan que detalle tales modificaciones. Dicho Plan debe asegurar que la calidad de agua potable servida no se verá afectada adversamente por tal modificación, entre otros requerimientos.

Estamos a su disposición para discutir cualquier duda o pregunta relacionada al Plan requerido o cualquier pregunta relacionada.

Sin otro particular, quedo.

OI Rivera

Olga I. Rivera
Directora
Programa de Agua Potable

OS/cm

Cf: José Sánchez- Team Leader Norte
Alex Ríos- Coordinador Area Aguadilla

22 de febrero de 2001

Sr. Jean M. Philipot
Director Técnico y Cumplimiento
Compañía de Aguas de Puerto Rico
Apartado 7066, Bo. Obrero Station
Santurce, P.R. 00916

Re: Cambio del punto de cloración en Planta de Filtración Sergio Cuevas

Estimado señor Philipot:

Luego de evaluar y considerar la solicitud del cambio en referencia sometida por la AAA/ Compañía de Aguas a este Departamento, le indicamos que autorizamos el mismo condicionado a lo siguiente:

1. Cumplir con los requerimientos contenidos en la parte 40 CFR 141.30 (f) para estos propósitos.

2. Someter un protocolo de muestreo para aprobación de este Departamento asegure que la calidad bacteriológica del agua potable servida por esta Planta no se verá adversamente afectada por el cambio en el punto de cloración. Este protocolo deberá incluir, sin limitarse a, los siguientes parámetros:

   - Muestreo para bacterias coliformes, coliformes fecales y estreptococos fecales
   - Conteo de placas estándar
   - Fosfato
   - Nitrógeno de amonia
   - Carbón orgánico total
   - Absorción específica de luz ultravioleta a 254 nm (SUVA-254) en: agua cruda, en lugar aplicación pre- cloración y en agua tratada
   - Potencial de formación de trihalometanos
   - Trihalometanos totales (TTHM's) diarios a la salida de la planta y en el sistema de distribución.

3. Mantener y demostrar en todo momento el residual de desinfectante activo requerido a través del sistema de distribución.

4. Mantener en todo momento las condiciones y modificaciones tal y como aparecen y se detallan en el Plan del cambio propuesto con fecha del 12 de febrero de 2001 aprobado por este Departamento.

5. Asegurar en todo momento el cumplimiento con el punto de referencia o "benchmark" según el Plan de cambio aprobado.

6. Asegurar en todo momento el cumplimiento con el mínimo de 3 log remoción/ inactivación de Giardia (99.9 %).

7. Someter informes semanales que incluyan la información antes requerida y el progreso del plan.

Esta aprobación para realizar la prueba del cambio de punto de aplicación de cloro propuesto será valida por treinta días calendario. Luego de esta fecha el Departamento de Salud evaluará su efectividad en la reducción de los TTHM's y llegará a una determinación final.

Sin otro particular, quedo.

OIRivera

Olga I. Rivera, MSA
Directora
Programa Agua Potable

Cf: Delia Olivo, DS
Ing. Jesús Sáez- DS
Ing. Elvin Vélez- CAPR
Ing. Emma Blanco, DS

APPENDIX M

PROTOCOL FOR DEMONSTRATION OF EFFECTIVE TREATMENT

This appendix presents approaches which can be taken to demonstrate overall effective removal and/or inactivation of *Giardia* cysts.

M.1 Demonstration for Alternate Technology

Systems using a filtration technology other than those enumerated in the SWTR may demonstrate the effectiveness of the treatment process through pilot or full scale testing. As a minimum, testing should be conducted when the source exhibits its worst case annual conditions. Some systems may have two periods of "worst case" water quality including the cold water in winter or algae blooms during the summer.

Pilot units should include the following:

- filtration rate of the pilot system equal to filtration rate on full scale unit
- pilot filter diameter greater than or equal to 50 times the media diameter, (Robeck, et al 1959)
- media diameter, depth, and size gradation should be identical to full scale,
- coagulant dosing identical to full scale
- any mixing and settling occurring before filtration in the full scale plant should be reproduced as closely as possible in the pilot. Mixing should be of the same G value(s), and the detention time for settling should be close to the average flow detention time for the projected full scale plant.

According to the SWTR, alternate technologies must be capable of meeting the same turbidity performance criteria of slow sand filtration systems. Thus the filtered water from the process should be monitored continuously or with grab samples every four hours for turbidity. The requirement for meeting turbidity performance has been established to

ensure that there will be no interference of turbidity with virus inactivation through disinfection.

Following the demonstration of meeting the turbidity requirements, the level of Giardia cyst removal achieved must be determined. The protocol in M.2 may be followed for this demonstration.

M.2 Particle Size Analysis Demonstration for Giardia Cyst Removal Credit

Particle size analysis may be used to demonstrate the level of actual Giardia cyst removal provided by the system. This demonstration can be done using samples from the full scale plant or a pilot unit.

In the case of either a full scale or pilot scale demonstration, removal of particles in the range of 5 to 15 um in diameter should be determined using an electronic particle counter that has been calibrated with latex spheres. If a light blockage device is used (e.g. HIAC) this calibration should have been done during installation of the device. The calibration should be checked before taking measurements for the purposes of this demonstration. Samples should be diluted appropriately to ensure that measurements do not reflect coincident error. Coincident error results when more than one particle passes the detector at one time, causing an inaccurate particle count and diameter measurement. An electrical sensing zone device (e.g. Coulter Counter or Elzone) may also be used. Appropriate dilutions, electrolyte strength, and calibration procedures should be followed (these are scheduled to be outlined in the 17th edition of Standard Methods). When using an electrical sensing zone instrument, an orifice no larger than 125 um and no smaller than 40 um should be used since only particles between 2% and 40% of the orifice diameter are accurately sized and counted (Karuhn et al 1975).

Samples of the filter influent and effluent should be taken 5 minutes after the backwashed filter is placed in operation, and every 30 minutes thereafter for the first 3 hours of operation, followed by hourly samples up until backwash (Wiesner et al 1987). All samples should show at least a 2-log removal. The SWTR establishes an overall treatment requirement of 3-log Giardia cyst removal/inactivation. Thus, disinfec-

tion must be provided to supplement the particulate removal and meet this requirement.

Samples from repeated filter runs may be averaged at each sampling time, but samples should not be averaged within one filter run.

Additional suggestions on particle counting technique (Wiesner 1985):

1) If particle counts are not determined immediately upon sampling (within 10 minutes) samples should be diluted.

2) For an electrical sensing zone measurement, samples should be diluted 1:5 to 1:20 with a "particle-free" electrolyte solution (approximately 1% NaCl) containing 100 particles per ml or fewer.

3) For a light blockage measurement, particle free water should be used to dilute samples.

4) Dilutions should be done to produce particle concentrations as close to the tolerance for coincident error as possible to minimize background counts.

5) Particle counts should be determined within 8 hours of sampling.

6) All sampling vessels should be washed with laboratory detergent, double rinsed in particle free water, and rinsed twice with the water being sampled at the time of sampling.

The log reduction of particles in the size range of 5 to 15 um in size can be assumed to correspond to the log reduction of Giardia cysts which would be achieved.

M.3 Demonstration for Increased Turbidity Allowance

Based upon the requirements of the SWTR, the minimum turbidity performance criteria for systems using conventional treatment or direct filtration is filtered water turbidity less than or equal to 0.5 NTU in 95 percent of the measurements taken each month. However, at the discretion of the Primacy Agency, filtered water turbidity levels of less than or equal to 1 NTU in 95 percent of the measurements taken every month